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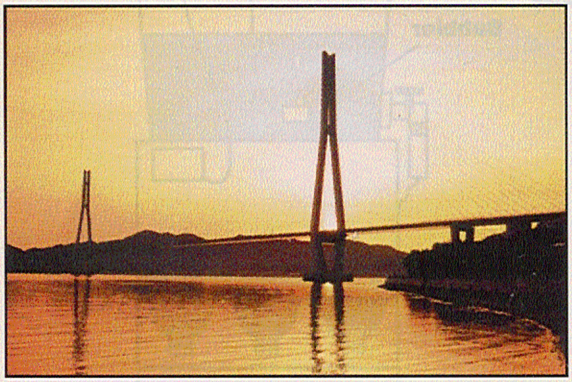
Bridges Built to Rock and Roll

THE Honshu-Shikoku Bridge Authority was established in Japan in 1970. In less than 30 years they have built 18 long-span bridges to create three routes that cross the Settee Inland Sea. They accomplished this task in a country known for its typhoons and earthquakes. If this doesn't impress you, let me add that their Akashi Kaikyo Bridge, which was completed in 1998, is 2.4799 miles long. It is the world's longest suspension bridge. It has a center span of 1,991 meters (1.2371 miles). Their Tatara Bridge, which was completed in 1999, is just under a mile in length (0.9196 miles long). It is the world's longest cable-stayed bridge. Tatara has a center span of 890 meters, or 0.5530 of a mile in length.

On January 17, 1995, the Hyogoken-Nanbu earthquake tested the seismic design of the Akashi Kaikyo Suspension Bridge. The bridge, which was still under construction, rocked, rolled, and moved with the earthquake without any damage to the structure. This earthquake lasted 20 seconds and measured 7.2 on the Richter scale. It ravaged Japan's sixth largest city, killed approximately 5,000 people, collapsed buildings, destroyed ports, and wrecked roadways. (Research this earthquake on the web at **www.seismo.unr.edu/ftp/pub/updates/louie/kobe/kobe.html**.)



Tatara Bridge
Photo courtesy of Honshu-Shikoku Bridge Authority.

The Tatara Cable-Stayed Bridge also had to prove its worthiness against the ravages of Mother Nature. It survived a typhoon during construction. The typhoon hit "while the center span was at its furthest extension, with the installation of the remaining final segment" yet to be completed. (An article on the typhoon versus the bridge, which makes for some exciting reading, can be found at **www.hsba.go.jp/bridge/tata_inf.htm**.)

A structure under construction often lacks the stability gained by the installation of all of its elements. Knowing that a significant event could happen at any time made it necessary to pre-engineer seismic and wind stability for all stages of construction on both of these bridges.

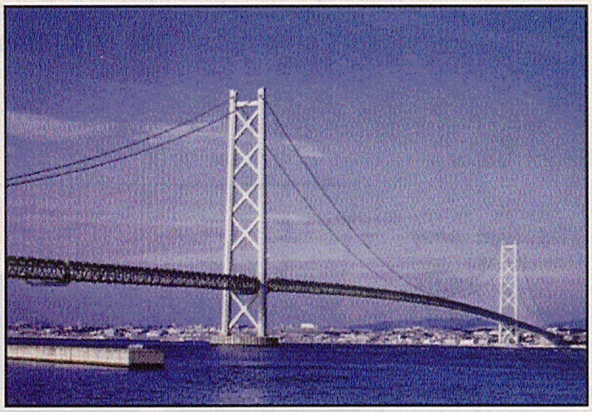
To analyze the geology of the ground upon which these bridges would be built, special large boring devices were developed. It was found that the foundation of the Akashi Kaikyo Bridge would sit on a geological area consisting of 40 percent gravel. As you can probably guess, gravel is unstable during an earthquake.

These ground conditions were used in computer models to determine the oscillations that could be expected during a seismic occurrence. Hydraulic model tests were made to determine the effectiveness of anti-scour measures that would help prevent the liquefaction of the ground around the bridge piers. The aerodynamic design of the Tatara Stayed Bridge was tested in a wind tunnel using a 1/200-scale model. A 1/100-scale model of the Akashi Kaikyo Suspension Bridge was also tested in a wind tunnel to determine its rotational stability.

But imagine: The bridges that will be built in the 21st century will no doubt eclipse the current accomplishments of the Honshu-Shikoku Bridge Authority.

Recalling the Facts

1. What do you think were the two greatest problems that the Honshu-Shikoku Bridge Authority had to solve during the design and construction phase of these two bridges?
2. Do you feel that "Bridges Built to Rock and Roll" was an appropriate title for this column? Why?
3. Why were wind tunnels used to test the designs of these two bridges?



Akashi Kaikyo Bridge
Photo courtesy of Honshu-Shikoku Bridge Authority.